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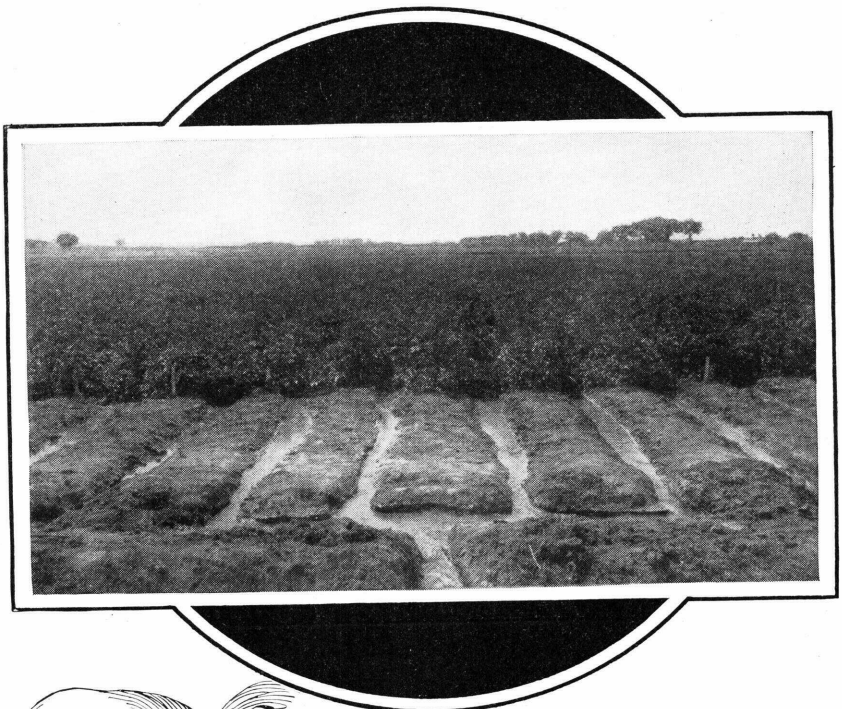
POTATO PRODUCTION

IN THE WESTERN STATES



FARMERS' BULLETIN No. 1843

U.S. DEPARTMENT OF AGRICULTURE

POTATO GROWING in the West is subject to soil and climatic conditions that are somewhat different from those of other potato-growing areas of the United States.

In the West most of the potatoes are grown under semiarid conditions, and the application of irrigation water is necessary to get maximum yields. The crop-rotation practices are peculiar to the West, and the use of commercial fertilizer, although increasing, is not as yet so widespread as in other regions.

Practices that have wide application are discussed in the main part of the bulletin, while those of less general interest are discussed under the individual States.

This bulletin supersedes Farmers' Bulletin No. 1639, Potato Production in the Far Western States.

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POTATO PRODUCTION IN THE WESTERN STATES

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INTRODUCTION

POTATO CULTURE in the Western States is largely confined to the irrigated sections. New irrigation projects are under construction, and additional water supplies are being added to some of the older irrigated districts. In recent years wells have been developed in some sections, giving an additional source of water. In addition to the potatoes grown under irrigation in these States, a considerable acreage is produced in the semiarid regions and also in the humid region of the Pacific coast. Potato growing in some of the dry-land sections is confined largely to the production of seed. There is much land available for potato production, and large yields are possible under irrigation. Many of the States can easily double or treble their present production whenever there is a profitable market for the crop. In order to improve the market quality, growers are paying more attention (1) to harvesting their crop with a minimum amount of bruising, (2) to washing or brushing the tubers to remove the dirt, (3) to better grading, and (4) to the appearance of containers for shipping.

The general information on potato production in this bulletin refers more particularly to Arizona, California, Colorado, Idaho, Montana, northwestern Nebraska, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Census figures for 1929 show that Colorado had the greatest potato acreage under irrigation, with Idaho second

and California third. Nevada had the highest percentage of its potato acreage under irrigation, with Utah, Idaho, and Colorado following in the order mentioned (table 1).

TABLE 1.—*Potato acreage and yield in Western States, 1929* [1]

State	Land planted to potatoes		Production	
	Irrigated	Total	From irrigated land	Total
	Acres	*Acres*	*Bushels*	*Bushels*
Arizona	784	1,807	84,183	156,642
California	23,238	31,658	5,569,976	6,489,203
Colorado	74,866	89,692	13,375,995	14,649,446
Idaho	68,276	76,609	13,705,836	14,304,596
Montana	8,880	20,673	1,208,190	1,842,812
Nebraska	16,507	100,908	2,425,853	9,350,327
Nevada	3,661	3,692	537,995	541,559
New Mexico	1,298	4,097	112,515	318,991
Oregon	8,083	33,039	1,451,959	3,364,289
Utah	10,371	10,798	1,914,875	1,975,277
Washington	19,143	43,908	5,063,896	7,188,337
Wyoming	7,890	19,952	1,122,396	1,834,305

[1] Data from the 1930 census report, based on the 1929 crop.

Commercial fertilizers are not generally used in potato production in the Western States. In the Stockton district of California large quantities of phosphorus and potash are applied, with beneficial results; and in Kern County nitrogen fertilizers are applied. In Montana, phosphate fertilizer has been found to be beneficial; this is also true in some parts of Wyoming, Colorado, Nebraska, and New Mexico. In other sections commercial fertilizers are occasionally applied, but their use is not general, growers relying on the natural supply of phosphorus and potash in the soil. In most districts nitrogen is supplied by turning under alfalfa, sweetclover, or other leguminous crops. Many of the most successful potato growers in the Western States apply large quantities of manure during the winter previous to potato planting or to some other crop in the rotation.

CROP ROTATION

The purpose of any rotation is to secure the largest yields per acre from the most profitable crops. A good rotation maintains the fertility of the soil and reduces weed troubles, insect pests, and plant diseases. Although there are no hard and fast rules relative to the length of a rotation, it is a rather common practice to keep the land in alfalfa 2 to 7 years, potatoes 1 year, and grain 1 year, and then go back to alfalfa. Where sugar beets are grown, potatoes are usually followed by beets and the beets by grain.

Very satisfactory results may also be obtained with sweetclover when a short rotation of crops is desired (fig. 1).

At the Colorado Potato Experiment Station, located at Greeley and operated by the United States Department of Agriculture, a 4-year crop-rotation system, consisting of a crop of potatoes on alfalfa sod, followed by a light seeding of barley or oats and an ordinary seeding of alfalfa, and then 2 years of alfalfa, has been used with satisfactory results.

In nonirrigated sections where the precipitation is insufficient or does not come at the proper season of the year, alfalfa is not used in the crop-rotation system. For example, in the Palouse country of northern Idaho and eastern Washington, the potato crop usually follows grain, field peas, or clover or is planted on fallow land. In the humid sections of western Washington and Oregon, and in portions of California, a great diversity of crop-rotation systems is possible.

FIGURE 1.—Adding humus to the soil by plowing under sweetclover.

SUITABLE SOILS

The potato is very cosmopolitan as to its soil requirements. It succeeds best, however, on sandy, gravelly, peat, or muck soil. Good crops are also produced on black loam or clay loam soils if the drainage is good. The essential quality for a good potato soil is that it shall remain porous during the growing season. The heavier soils are more difficult to prepare, are inclined to puddle when irrigated, and produce misshapen tubers. Poorly drained soils or those with an impervious subsoil should always be avoided. Subsoils of this nature may prevent the drainage of surplus water so that the upper soil, even though light and sandy in nature, is not properly aerated.

PREPARATION OF THE SOIL

In the preparation of the land for potatoes the main objectives to be attained are: (1) To kill the alfalfa or other sod, when present; and (2) to pulverize the soil to form a mellow seedbed. It is impossible to produce maximum yields from poorly prepared land. Whether the soil should be plowed in the fall or in the spring depends largely on its physical character and the previous crop grown. If the soil is heavy, it would be benefited by being exposed to the action of frost, snow, and rain during the winter; on the other hand, if the exposure of the land will render it liable to undue erosion and

blowing during the winter, it would be better to plow it in the spring.

In some districts of the West, alfalfa is turned under just before planting time without trouble ensuing from the cut-off crowns or from surviving alfalfa plants. Thorough plowing is very important. Plows not equipped with alfalfa shears frequently leave some plants uncut. The plow should be followed by the harrow, which will drag out most of the short crowns of alfalfa that have been cut off. On the heavy soils it is a good practice to follow the plow

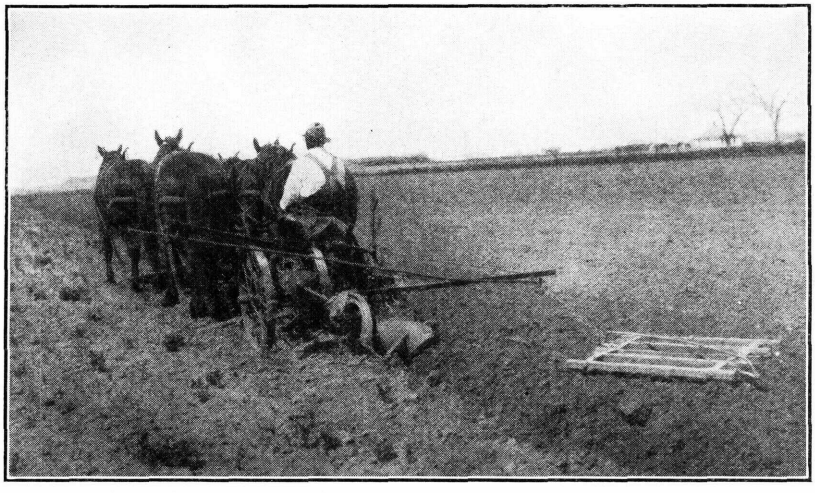

FIGURE 2.—Plowing fall-crowned alfalfa. A small harrow attached to the plow prevents the formation of clods.

with the harrow within 2 or 3 hours to pulverize the soil and prevent the formation of clods (fig. 2). It is a good practice to harrow before noon the land plowed in the morning, and to harrow the afternoon plowing before leaving the field at night.

In plowing alfalfa sod in the fall, it is a common practice to plow it to a depth of 3 or 4 inches, or just deep enough to cut off the crowns of the alfalfa plants (fig. 3). The land is then plowed deep in the spring.

In some sections growers are now using a land chisel, with beneficial results, to loosen the soil to a depth of 16 to 20 inches.

The seedbed should be prepared so that the soil around the seed pieces is moist. In some sections it is a good practice to pack dry or loose soil with a subsurface packer after planting.

The importance of a thoroughly prepared seedbed cannot be overemphasized. Land that is plowed too wet usually remains in poor condition throughout the growing season. No subsequent cultivations can make up for a poorly or carelessly prepared seedbed.

SEED

IMPORTANCE OF GOOD SEED

Although much has been said and published regarding the importance of good seed, each year presents overwhelming evidence

that many growers continue to use inferior seed. Good seed should be free from freezing injury and disease; it should be of good type, true to name, sound and firm, and not more than 9 or 10 ounces in weight, a weight of 4 to 6 ounces being preferred. Through the seed-certification agencies that have been established in practically all States, growers now have a reliable source of seed, and they may purchase seed through these agencies or direct from the seed growers.

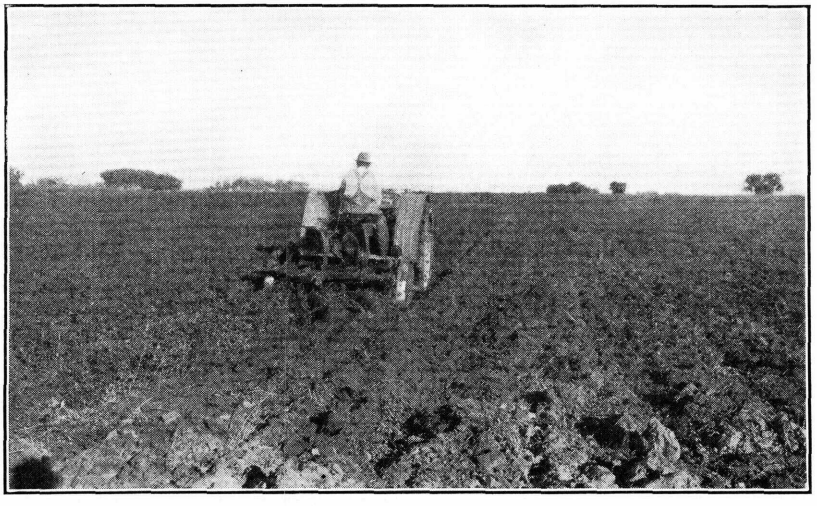

FIGURE 3.—Fall crowning of alfalfa.

IRRIGATED VERSUS NONIRRIGATED SEED

Many potato growers in irrigated districts and elsewhere have been prejudiced against the use of seed grown with the aid of irrigation water, the common belief being that such water impairs the vigor and vitality of seed.

Studies concerning the effect of irrigation water on vigor and vitality of seed potatoes were conducted at the Colorado Potato Experiment Station at Greeley, 1921–29. The results obtained from these tests indicate that irrigation water had no effect on the vigor and vitality of seed. Similar conclusions have been reached in other States. Climatic conditions doubtless have some influence on the seed as well as on the life of insects that carry potato diseases, especially virus diseases. The large vine growth developed under irrigation makes the roguing of seed fields more difficult, often hiding weak and diseased plants. Disease is spread more rapidly because of rank vine growth and contact of one plant with another.

Many growers in the irrigated districts prefer to devote their time to the production of table stock and buy their seed from the growers specializing in seed production.

Every grower who produces his own seed should maintain an isolated plot planted in tuber units. These units consist of the four quarters of selected tubers, planted consecutively, with sufficient space left between each unit so that the plants from each tuber may be easily distinguished. Tubers weighing from 6 to 9 ounces are of a good size to select for tuber-unit planting.

SEED TREATMENT WITH DISINFECTANTS

The value of seed treatment is still doubtful in some sections largely because of the fact that where soils are heavily infested with scab or rhizoctonia there is apparently little benefit derived from seed treatment. As a rule, however, it pays to treat, before planting, seed infected with scab or rhizoctonia. Virus diseases or any others caused by organisms located within the tuber are not affected by seed treatment. The effectiveness of the treatment is largely dependent upon how closely the operator follows directions, as serious sprout injury may result from seed treatment if the proper method is not followed. Seed treatment should be regarded in the nature of a safeguard.

The materials in use as seed-potato disinfectants are mercuric chloride (corrosive sublimate), acid mercury (mercuric chloride and hydrochloric acid), formaldehyde (cold and hot), and organic mercury compounds.

The standard solutions and time of treatment in use for these materials are as follows:

Mercuric chloride.—Four ounces of mercuric chloride (corrosive sublimate); 30 gallons of water. Soak whole tubers 1½ to 2 hours in the solution, using sacks (fig. 4) or wooden crates as containers; then allow to dry.

> Corrosive sublimate is a deadly poison, and every precaution should be observed in its use. It should never be put into metal containers unless they are covered with a coating of asphaltum or other protective material. After four treatments, discard the solution.

Acid mercury dip.—Dissolve 6 ounces of mercuric chloride (corrosive sublimate) in 1 quart of hydrochloric acid; 25 gallons of water. Soak whole tubers 5 minutes.

Add the dissolved mercuric chloride and hydrochloric acid to water in a wooden barrel. Place tubers in wooden picking baskets and submerge for 5 minutes. Remove tubers and dry. One solution will treat 25 to 30 bushels of seed. **This solution is deadly poison.**

The acid mercury dip is gaining in favor over the old mercuric chloride treatment because of the short time required in the treating process. The tubers should be treated before the sprouts become active or sprout injury may result, and after treatment they must be well dried at once to prevent injury to the eyes and skin of the seed tubers.

Formaldehyde.—One pint of formalin (40-percent formaldehyde); 30 gallons of water. Soak whole tubers 1½ to 2 hours.

Hot formaldehyde.—Two pints of formalin (40-percent formaldehyde); 30 gallons of hot water. Immerse tubers in hot solution (125° F.) for 3 to 4 minutes.

The hot formaldehyde treatment has become popular in some sections, and large quantities of seed are treated at community treating plants. Where such practice prevails, the seed is usually treated in sacks and is allowed to dry in them (fig. 5). Presoaking adds to the effectiveness of the treatment. This consists in dipping the tubers

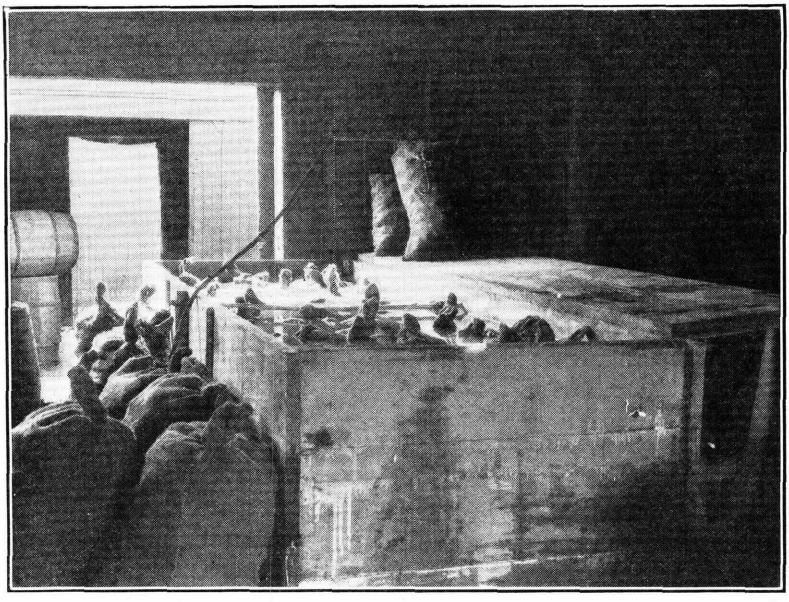

FIGURE 4.—Large tank commonly used for treatment of seed potatoes with mercuric chloride (corrosive sublimate).

FIGURE 5.—Small hot formaldehyde seed-treatment outfit suitable for use on the farm.

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in water, draining and allowing them to stand in the moist sacks, or covering them with sacks, for 24 hours before treating. After treatment with hot formaldehyde, potatoes should be covered for an hour, then the sacks should be set aside to dry.

The organic mercury compounds are known as instantaneous dips. These materials are not corrosive and may be used in metal containers. Seed may be treated with the organic mercury compounds, 1 pound being sufficient to treat from 20 to 25 sacks of seed. Seed should be placed in picking baskets and submerged in solution. Baskets should then be removed and placed on a drain board so that excess solution may drain back into the container.

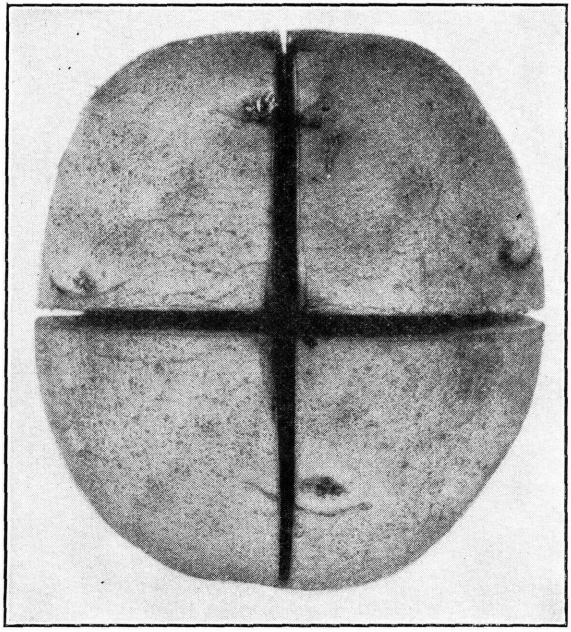

FIGURE 6.—Large blocky seed pieces insure good stands.

CUTTING THE SEED

Some growers in the irrigated sections plant whole seed. One argument in favor of whole seed is that there is less danger of its rotting or drying out in the soil before the sprouts are rooted than there is with cut seed. It is also quite possible that there is less fusarium wilt infection from the soil in fields planted with whole seed. Good whole seed is difficult to obtain; the common source is the small tubers from commercial fields. Only small whole seed from healthy plants should be used.

Poor stands are nearly always due to seed-piece rot, which is generally more severe as the cut-surface area increases. Therefore, seed cut from large tubers requires more care in handling than that cut from small tubers.

Usually seed pieces are cut too small. It should be borne in mind that a large seed piece (fig. 6) has a much better chance to produce

a sturdy sprout under unfavorable soil conditions than a small one. Numerous machines for cutting seed potatoes are on the market, some of them being designed for hand and others for power operation. Although such cutting devices reduce the time element, a small number of no-eye pieces may be expected. This is especially true with varieties having few eyes near the stem end. There is no satisfactory substitute for careful cutting of seed by hand. The efficiency of the individual may be materially increased by using a cutting box with a rigidly fixed knife blade. This plan of cutting is illustrated in figure 7. With this particular arrangement the operator cuts the

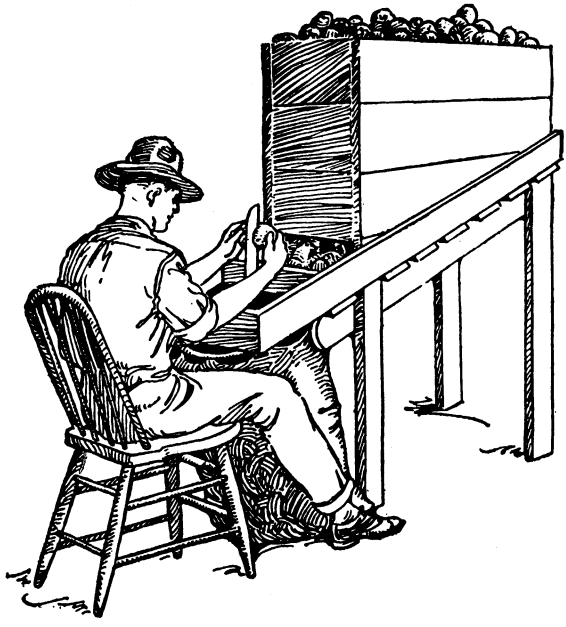

FIGURE 7.—A cutting box with a rigidly fixed knife blade. This makes it possible to cut a larger quantity of potatoes in a day than where the knife is held in the hand.

potato by pulling the tuber toward him. Some prefer to drive the knife into the end of a piece of board in such a way that the operator can sit on the board and push the potato across the upright blade of the knife. Where a large amount of seed is to be cut, large hoppers are arranged that hold several sacks of seed. The hoppers are constructed in such a way that the tubers roll down to the hand of the operator in front of the knife. As the potatoes are cut, the pieces fall into a basket or sack. There is very little lost motion if this method is employed.

CARE OF FRESHLY CUT SEED

Potatoes are generally planted as soon as they are cut, but they may be cut some time in advance of planting if properly suberized by being allowed to heal at a temperature of from 60° to 70° F. with an 85-percent atmospheric humidity. Freshly cut seed frequently heats if put into sacks and placed in a pile. Cut seed placed in the

sun on a hot day for any length of time may start to decay soon after it is planted. Most growers take care not to cut a very large quantity of seed ahead of the planter lest rains cause delay, in which case the cut seed may deteriorate unless properly handled. Cut seed pieces should not be put into unwashed fertilizer bags.

Suberization of seed is not recommended unless it can be properly done; partial suberization of seed is of no benefit. One of the best places to suberize seed is the potato-storage cellar, if the correct temperature and moisture requirements can be maintained. Eight or ten days are required for suberization, after which the seed may be planted or stored if placed at a cool temperature. Cut seed to be suberized should not be stored or handled in bags, because of lack of ventilation. Two days after they are cut, the pieces should be poured from one container to another to break apart the pieces sticking together. Seed suberizes naturally if planted in soils having suitable temperature and moisture. Suberization is good assurance against seed-piece decay in case potatoes are planted in dry soils or soils having a high temperature.

In some sections where seed is cut a few days in advance of planting, it is a common practice to spread the freshly cut seed on the floor of the potato-storage cellar to a depth not to exceed 6 to 7 inches. If placed on sacks, the seed can be easily picked up at the time it is to be taken to the field. In some sections where the air is very dry or the sun is bright, it is a good practice to shade all seed taken to the field for planting and also seed left in the planter during the noon hour.

PLANTING

Seed pieces are usually planted 3 to 5 inches deep; in any case it is best to plant them sufficiently deep to make sure that they are placed in and covered with moist soil. Shallower planting is practiced more often with the early than with the late crop; deep planting is more necessary under dry-land farming than under irrigation.

There are three types of planters: The picker, cup-type, and the assisted-feed planter, each having its advantages and disadvantages.

The picker-type planter is most generally used because of its economical operation. Good stands may be secured with this type of machine if the seed is cut into blocky seed pieces of a fairly uniform size. However, the pickers, jabbing into the seed pieces, may spread disease from one seed piece to another. Picker planters should be checked frequently to make certain that they are functioning properly. The cup-type planter is best adapted for planting whole seed; it is used as a one-man or two-man planter. The assisted-feed planter requires two men to operate it. Planting with this type of machine is slower, but, with a good man on the rear a perfect drop should be secured.

Two-, three-, and four-row planters are now in use by some of the large operators. These planting units are drawn by tractors and plant large acreages in a single day.

SPACING

The chief considerations determining the distance between rows are the fertility of the soil and the available soil moisture. In dry-land

potato production a much wider row spacing is necessary than under irrigation; the distance between rows is generally 42 inches, and the seed pieces are spaced from 15 to 18 inches in the row. Where rainfall is sufficient to produce a good crop, as, for example, in the western portions of Oregon and Washington, the seed pieces are spaced about the same as on irrigated land.

Under irrigation the distance between rows varies somewhat, but usually as a matter of convenience in cultivating, ditching, irrigating, and digging, the rows are spaced 34 to 38 inches apart, and the seed pieces are planted 9 to 14 inches apart in the rows, depending on the variety and the fertility of the soil. For early potatoes, the distance between the rows is sometimes reduced to 30 or 32 inches. Wide ridges are important in growing potatoes in most of the irrigated districts, as they give ample room for tuber development and also afford frost protection in the fall. Close spacing is made necessary with some varieties when grown under irrigation to reduce the size, to minimize the growth cracks and hollow heart, and to secure maximum yields.

The quantity of seed required to plant an acre of potatoes varies with the size of the seed, the spacing of the seed pieces in the row, and the distance between rows. Table 2 gives the number of bushels of potatoes required to plant an acre at different spacings with seed pieces of various sizes. Under irrigation, yields are generally increased in proportion as the quantity of seed used is increased.

TABLE 2.—*Number of bushels of potatoes required to plant an acre at different spacings with seed pieces of various sizes*[1]

Spacing between rows (inches)	Spacing between seed pieces	Bushels per acre required when seed pieces weigh—				
		1 ounce	1¼ ounces	1½ ounces	1¾ ounces	2 ounces
	Inches	*Number*	*Number*	*Number*	*Number*	*Number*
30	8	27.2	34.0	40.8	47.6	54.4
	10	21.8	27.3	32.6	38.1	43.6
	12	18.2	22.7	27.2	31.8	36.3
	14	15.6	19.4	23.3	27.2	31.1
	16	13.6	17.0	20.4	23.8	27.2
32	8	25.5	31.1	38.3	44.7	51.1
	10	20.4	25.5	30.6	35.7	40.8
	12	17.0	21.3	25.6	29.8	34.0
	14	14.6	18.2	21.9	25.5	29.2
	16	12.8	16.0	19.2	22.4	25.6
34	8	24.0	30.0	36.0	42.0	48.0
	10	19.2	24.0	28.8	33.6	38.4
	12	16.0	20.0	24.0	28.0	32.0
	14	13.7	17.1	20.6	24.0	27.4
	16	12.1	15.0	18.0	21.0	24.0
36	8	22.7	28.4	34.0	39.7	45.4
	10	18.1	22.7	27.2	31.7	36.3
	12	15.1	18.9	22.7	26.5	30.2
	14	13.0	16.2	19.4	22.7	25.9
	16	11.3	14.2	17.0	19.8	22.7
42	18	8.6	10.8	13.0	15.1	17.3
	24	6.5	8.1	9.7	11.3	13.0
	30	5.2	6.5	7.8	9.1	10.4
	36	4.3	5.4	6.5	7.6	8.6

[1] STUART, WILLIAM. THE POTATO. 518 pp., 1923.

IRRIGATION

Where furrow irrigation is to be practiced, furrows must be made before the water is applied (fig. 8). The type of furrow to be made depends on the type of soil and the slope of the land. Ordinarily, furrows are made by attaching special ditchers to a two-row cultivator with the shovels removed. On flat land with heavy soils the irrigation furrows must be deep and broad so that the water will not reach the top of the ridges but may be forced quickly to the far end of the rows. If the land is steep or of a type that will wash badly, a small furrow should be used.

The production of maximum yields and the quality of the crop grown under irrigation depend largely on the proper application and use of water. The quality of the crop is not injured by water if

FIGURE 8.—Field of potatoes ditched for irrigation.

wisely and properly used. In some sections 3 or 4 applications of water may be sufficient to grow a crop, whereas in another section 5 or 6 or even 10 applications may be necessary to produce maximum yields. In any section the number will vary from year to year with the variation in rainfall and seasonal conditions. As a result of 14 years of study at Greeley, Colo., of early and late applications of the initial irrigation, frequent and infrequent, and light and heavy irrigations, it was found that when the proper soil moisture was maintained to enable the plants to make a continuous, vigorous growth throughout the growing season, or rather up to the time the tubers had reached full size, larger yields were consistently obtained. It was found that frequent light applications of water (2 to 4 acre-inches) were preferable to infrequent, heavy ones (4 to 5 acre-inches). The common method of applying water by running a small head of water in each row is shown in the cover illustration. Figure 9 shows an adjustable canvas check dam that may be used in a head

ditch to check the flow of water and raise the water level. Figure 10 shows check dam in place in a head ditch.

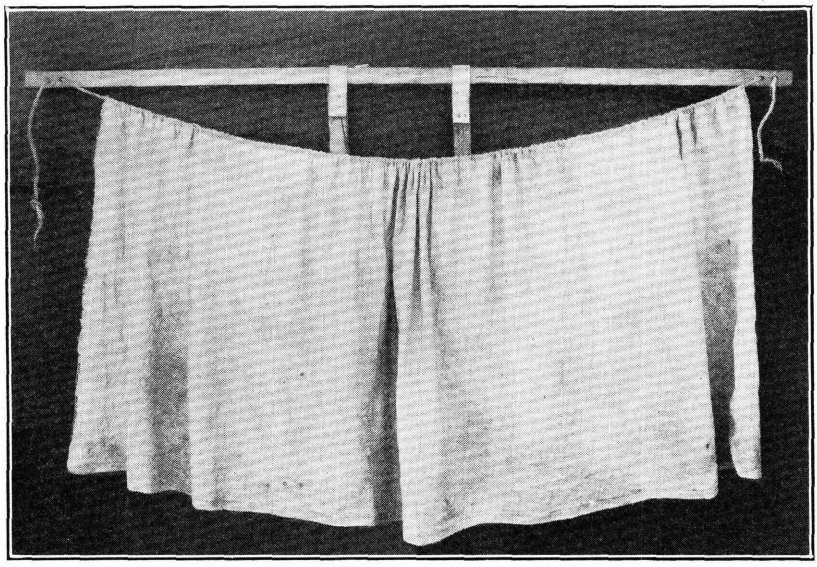

FIGURE 9.—Adjustable canvas check dam used in head ditch to check the flow and raise the water level.

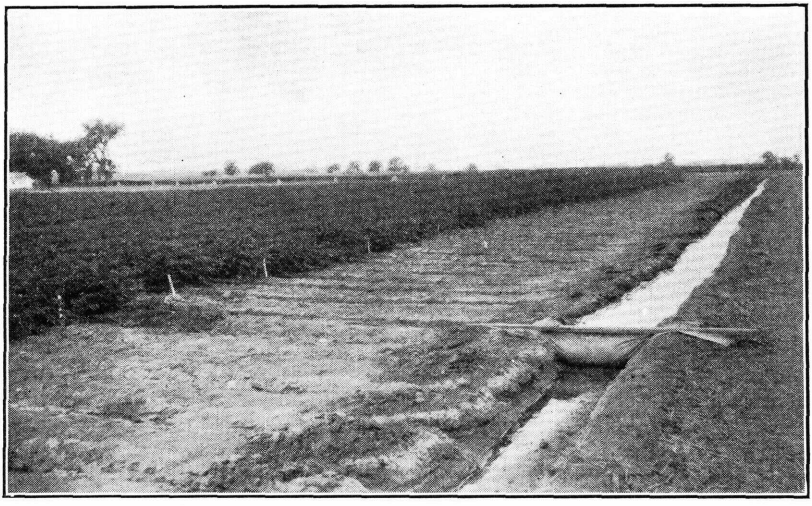

FIGURE 10.—Head ditch with canvas dam in place. Two or three such dams are sometimes used if necessary to obtain even distribution of the water in the furrows.

Owing to the variation in the water-holding capacity of different soils and the influence of temperature, rainfall, and other seasonal conditions, it is impossible to prescribe a time when the first irriga-

tion should be applied, the number of irrigations, or when the last irrigation should be given, but it is believed that the following general rule can be followed with good success: Apply the first water whenever the plants seem to require it in order to make a continuous, vigorous growth (fig. 11). After the first irrigation, the soil should

FIGURE 11.—Plants grown from seed pieces. Triumph variety planted on the same date. The plant on the left was grown in moist soil; that on the right was grown in comparatively dry soil. Note early set of tubers developed on plant grown in moist soil.

be kept moist by light or medium-light irrigations until the tubers have reached full size. The ideal condition is to have all the soil except the top of the ridge continuously moist. In a deep soil constant moisture near the surface is less vital. In general, sandy soil when saturated holds approximately 2.5 to 3 inches of water per foot; however, only about half of this amount is available for plant use. Heavy clay soils are finer in texture and have a higher water-holding capacity, ranging from 3.5 to 4.5 inches per foot, of which 2 to 3 inches is available for plant use. The adequacy of moisture in the soil may be determined by examination of the soil 8 or 10 inches beneath the top of the ridge, by the condition of the plants, and by the color of the foliage. Plants supplied with proper moisture should appear vigorous and have foliage color typical of the variety. Lack of moisture in the soil causes the plants to become dark, whereas an oversupply causes the foliage to assume a lighter color than is normal for the variety.

In all irrigated sections of the West except the peat lands of the delta region at the confluence of the San Joaquin and Sacramento Rivers in California, the customary practice is to run irrigation water through ditches or furrows between the rows of potatoes. On

the peat land, ditches spaced 60 to 75 feet apart and 24 to 30 inches deep are cut between rows of potatoes. These irrigation ditches are connected with a head ditch which receives its supply of water through a head gate or siphon direct from the river or canal. When a tract of land has received the proper amount of water, the supply is cut off, and the water level in the ditch is lowered by pumping the excess water back into the river. Some potato lands in the San Luis Valley of Colorado are irrigated by raising and lowering the water table in much the same manner.

In most of the irrigated sections of the West the irrigation water is run in furrows between the rows or between pairs of rows, depending on the slope of the ground, length of row, and type of soil. These furrows should be comparatively deep and narrow so that the water may be applied to the area below the tubers. On steep slopes, small streams must be used to prevent washing. The length of run should be governed by the type of soil; shorter runs should be used on lighter soils where the water percolates into them more rapidly. If deep furrows are used, there is less tendency to pack the soil in the potato rows.

FIGURE 12.—Irrigating plowed ground before planting, to supply moisture for sprouting seed.

"IRRIGATING UP"

In some districts, owing to insufficient snowfall and spring rains and desiccating winds or continued hot weather, it becomes necessary in some years to irrigate the land before planting (fig. 12), or to "irrigate up" the newly planted crop. The term "irrigating up" refers to the application of water after planting to supply moisture to facilitate germination. If spring plowing has been delayed, the land may be irrigated before plowing. When alfalfa sod has been

crowned in the fall and the land plowed early in the spring, it is not practical to irrigate the soil by flooding, but it may be furrowed or ditched and irrigated before being planted. If the soil lacks sufficient moisture to germinate the sets, water may be supplied after planting. When seed of liberal size has been used and the planting has been sufficiently deep, strong, sturdy sprouts may develop, but soil moisture must be available before roots will form on the sprouts (fig. 13).

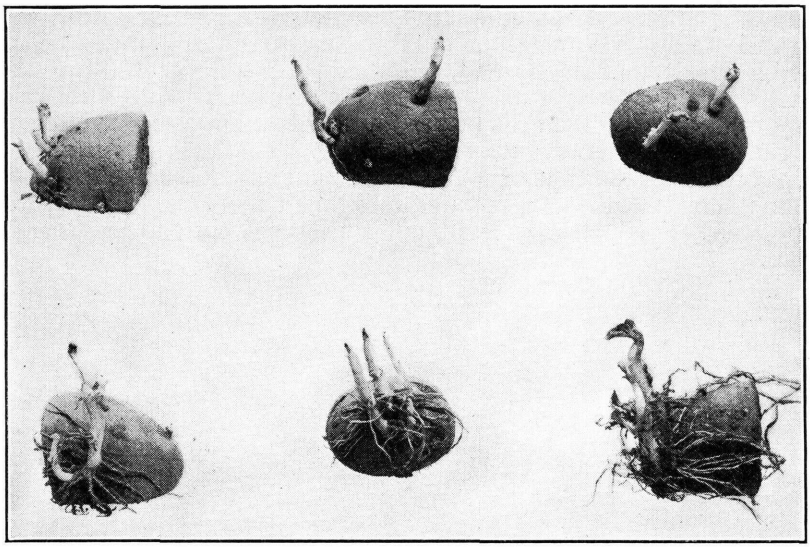

FIGURE 13.—The seed pieces in the top row were taken from dry soil; those in the bottom row from moist soil. Note the absence of roots on the upper seed pieces. All were planted on the same date.

"Irrigating up" the crop after planting must be done very carefully, or the seed will decay; this is especially true where cut seed has been used. The most successful method is to irrigate until the moisture reaches the seed piece or sprout, but suspend irrigation before the soil above the seed piece becomes wet. This method has resulted in good germination and little seed-piece decay (figs. 14 and 15).

Irrigating in the fall or early spring is good practice if water is available. Applying the water before planting is far preferable to irrigating after the seed is in the ground.

CULTIVATION

Systems of cultivation differ greatly in the different potato districts and also within the districts themselves. The practice of using a harrow or weeder on the potato field before the plants emerge from the soil is gaining in favor. This method of tillage kills weeds that grow in the row and is very useful in breaking the crust that sometimes forms after rains. The subsequent cultivation of the crop is dependent on whether it is being grown under dry-land, humid,

or irrigation conditions. Under dry-land conditions two or three cultivations are generally sufficient. With soils that are inclined to

FIGURE 14.—"Irrigating up" a newly planted field of potatoes. Where the rows are short the water is run between all the rows.

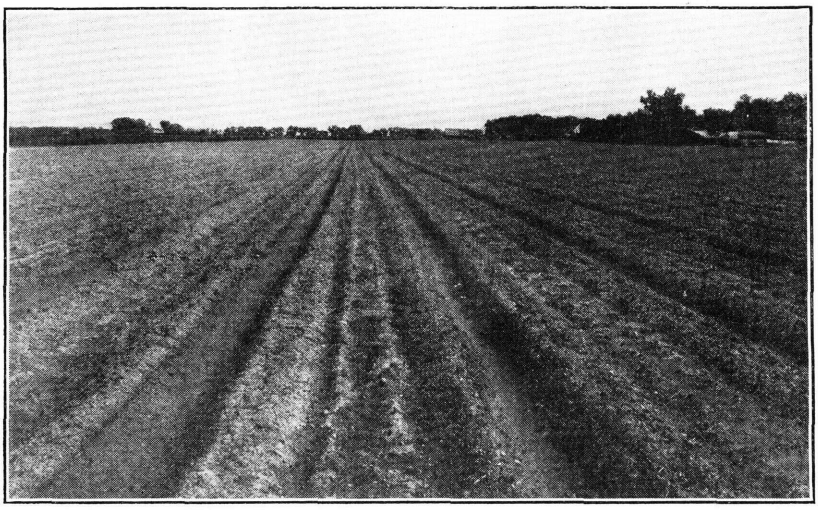

FIGURE 15.—Ditches made between alternate pairs of rows for "irrigating up." With long rows this is a common method of applying water.

pack and run together under irrigation, the best results are obtained if a cultivation is given soon after planting. Machine planters leave a ridge over the potato row that can be easily followed. In some

sections this first cultivation is very deep, usually 12 to 14 inches (fig. 16). The shovels on the cultivator are set to work the soil toward the row, thus forming a wide ridge at the row and a ditch in the middle of the space between the rows. The number of cultivations varies with conditions; the purpose is to kill weeds and aid surface absorption of water.

SPRAYING AND DUSTING

Spraying or dusting for protection against insect pests is practiced as a measure of control in many of the Western States, the pests involved being the Colorado potato beetle, flea beetles, blister beetles, and the potato psyllid. The remedy for chewing insects is some form of stomach poison such as calcium arsenate, lead arsenate, zinc arsenite, paris green, barium fluosilicate, or sodium fluosilicate. Lime-sulfur spray is used for the potato psyllid, a sucking insect.

FIGURE 16.—Deep cultivation after planting. Shovels set to work the soil toward the row, forming a wide ridge.

For flea beetles, which in their adult stage injure the potato foliage and in their immature stage attack the tuber, spraying with zinc arsenite or dusting with calcium arsenate appears most effective in some sections, whereas in others dusting with sodium fluosilicate and barium fluosilicate is recommended. Complete control with insecticides, however, is extremely difficult.

Psyllid yellows, known locally as "blight" or "purple top," occasionally causes severe damage to the potato crop in some sections. The injury is caused by the nymphs of the potato psyllid feeding on the under surface of the leaves. The control method now employed in some States is spraying with lime-sulfur. The material is applied at high pressure with three nozzles in a row, the two lower ones being turned upward at an angle to cover the under surface of the leaves. The success of this treatment depends upon its thor-

oughness and timeliness. In sections where flea beetles are injurious, sprays for the two insects are generally combined.

HARVESTING AND MARKETING

In the early-producing sections, the potato crop is usually harvested when it is more or less immature. High prices and an active demand often induce growers to harvest immature or partially grown tubers.

Potatoes for early market that are dug during hot weather should be picked up immediately after digging to prevent sunscald injury; if the temperature is much higher than 90° F. and the weather is clear, it may be safer to harvest only during the cool part of the day, that is, before 9 or 10 a. m. and after 4 p. m.

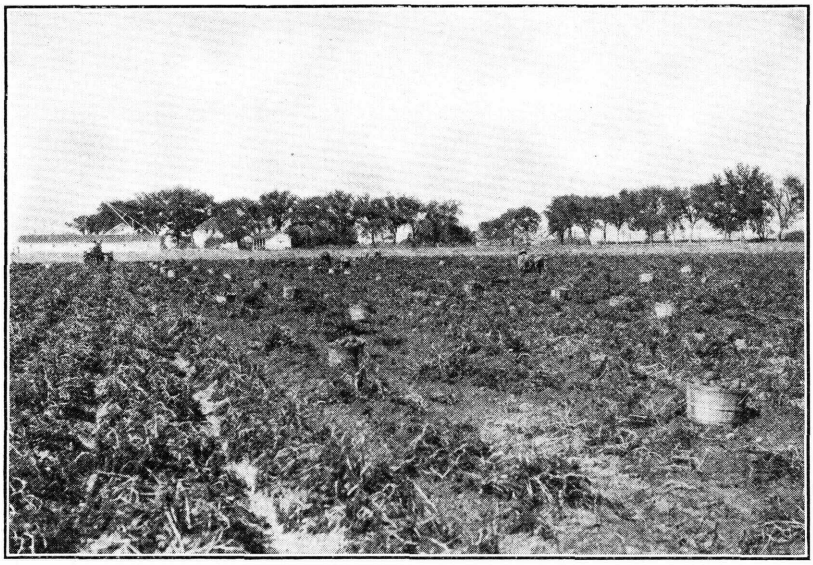

FIGURE 17.—Harvesting potatoes in bushel baskets. Baskets are taken to the storage cellar and carefully emptied; much bruising is thus eliminated.

Except for the early crop, potatoes should not be dug until the tubers are thoroughly ripe or mature. Immature tubers scar easily and unless handled very carefully make a poor appearance on the market. Tubers injured at time of harvest are likely to be attacked by dry rot or wet rot in storage. Potatoes should be harvested as carefully as possible. This is especially true when Triumph or other thin-skinned varieties are grown for the late crop. In some sections wire picking baskets have been eliminated and containers that cause less bruising of the tubers have become popular. If wire baskets are used they should be padded. Much tuber injury can be eliminated at the time of harvest if the potatoes are picked in bushel baskets, then taken to the storage cellar and carefully emptied into the bin from the same containers (fig. 17). Potatoes are frequently damaged by pouring them through chutes into the storage cellar instead of carrying them to the bins.

Practically every commercial potato grower uses a machine digger. This elevates the potatoes over a carrier chain which separates the tubers from the soil. The diggers are drawn either by horses or tractors (fig. 18). Many of the larger operators now using tractors dig two rows in one operation, and some three-row diggers are used in the Stockton district of California. Diggers with low-type elevators with a continuous chain eliminate much of the bruising. Covering the ends of the chain links so that they will not injure the tubers is a common practice in some sections.

The early potato crop is usually marketed as it is harvested. It is a common practice in some sections to sell direct to truckers who come to the fields and buy the potatoes as soon as they are sacked.

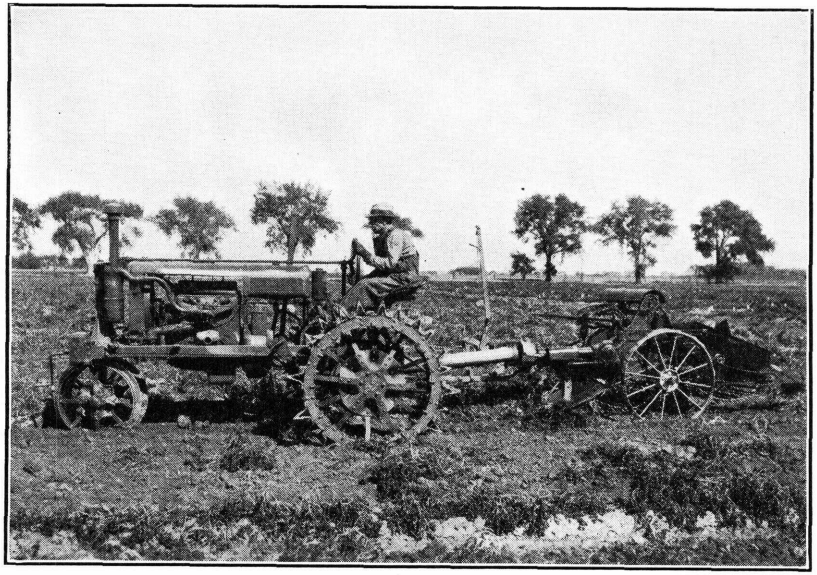

FIGURE 18.—One-row potato digger with continuous chain—a common type of digger.

In most sections a large percentage of the late crop is placed in storage at the time of harvest. Throughout the West the crop is marketed in new branded burlap sacks; however, cotton bags, small cartons, or boxes are also being used.

In some sections washing the potatoes has become a common practice (fig. 19).

STORAGE

Since it is hardly possible for growers to dispose of all their crop at the time of harvest, every grower should have some provision for storage. A large part of the late crop must be stored on the farm or in trackside storage houses, or in the centers of consumption. The type of storage house depends largely on the climatic conditions in the section where the potatoes are stored. Probably the best type of storage house is found in the Mountain States. They are constructed in a knoll or a hillside or on level land and usually are

arranged so as to permit driving into them through at least one end, and in many cases driving through. The soil-covered storage cellar or dugout is practical only in sections of comparatively light rainfall. In the sections of Oregon and Washington where the winters are mild, potatoes are stored in pits, farm cellars, trackside storage houses, and various types of storage rooms. In the Klamath section of southern Oregon, storage cellars similar to those in the Mountain States are being used.

The main purposes of storage are to keep the potatoes from freezing and to have as little loss as possible from rots or shrinkage.

One of the most important factors in the interior arrangement of the cellars is the provision for the circulation of air. Bins that have

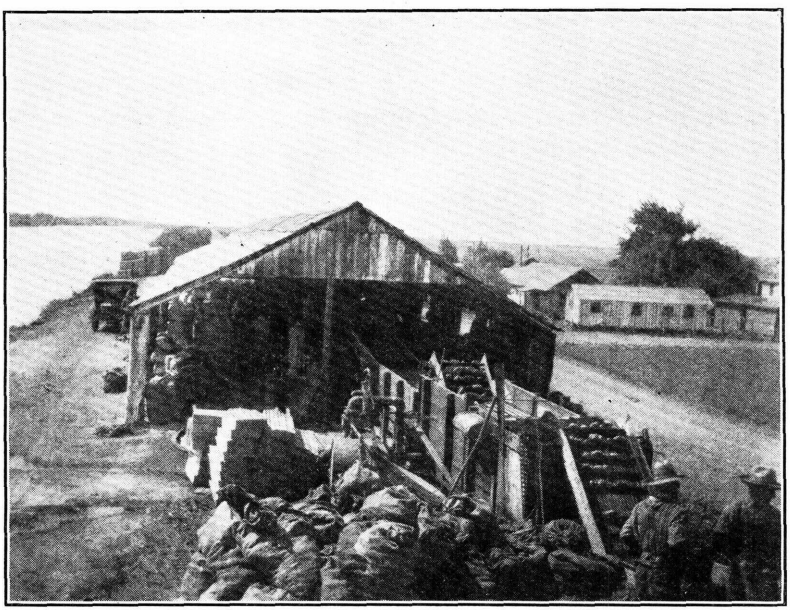

FIGURE 19.—Washing potatoes—a common practice in some sections.

slatted floors and are divided by solid walls are very satisfactory. Storing tubers at a depth of 15 to 20 feet is not too great if bins are well ventilated. Special attention should be given to the regulation of temperature and ventilation and to the exclusion of light.

The temperature of the storage cellar should not be lowered for 2 weeks after the tubers have been placed in storage. Tuber injuries heal best if the temperature remains about 60° F. with an atmospheric humidity of about 85 percent. Some growers wet the soil under the bins before placing the potatoes in storage and then sprinkle the driveway when necessary, to provide proper moisture conditions. After the injured tubers have healed, the temperature should be lowered to that desired for regular storage. For the normal potato-storage period, a temperature of from 36° to 38° with a high relative humidity will be found very satisfactory. Under good storage conditions the loss of moisture from evaporation and from decay should not exceed 5 or 6 percent.

Very little ventilation of the storage cellar is needed during the winter, but it is necessary at times to lower the temperature. The cellar should not be ventilated when the outside temperature is higher than that inside, because of danger from condensation of moisture which encourages both decay of the potatoes and of the building itself. A thermometer should be kept in the storage cellar and inspected regularly.

DRY-LAND POTATO PRODUCTION

Dry-land potato production is of considerable importance in some of the Western States, especially Nebraska, Montana, Wyoming, Colorado, and Idaho. Much of the dry-land crop is produced for seed, either certified or noncertified.

Many of the dry-land seed growers have become very proficient in growing seed; their understanding of potato diseases has been largely responsible for the success of the industry. Some State experiment stations have developed special strains that have been made available to seed growers for their foundation stock.

Owing to the small amount of rainfall in most dry-land sections, the success of the crop depends largely on the amount of rainfall during the growing season and the quantity of moisture stored in the soil before planting. In some dry-land sections a common practice is to plant the crop on summer-fallowed land or following some cultivated crop such as beans or corn. Small grain is generally considered undesirable as a crop to precede potatoes because it exhausts practically all available soil moisture to a depth of 4 or 5 feet. The best results are obtained by storing moisture on summer-fallowed land the year preceding the planting of a potato crop. "Basin listing," a furrow and check method for preventing surface run-off, may be beneficial in dry-land potato growing. This method consists of constructing listed furrows in which small earthen dams or checks are made at regular intervals during the listing operations. All rains are thus held and surface run-off prevented.

Plantings are usually made between June 10 and 20. The rows are spaced 42 inches apart with the seed pieces spaced from 14 to 30 inches apart in the rows. Level cultivation is practiced in order to conserve the moisture, and only sufficient cultivation to kill the weeds and maintain a surface mulch is practiced.

In some of the dry sections it is advisable to practice long crop rotations in order to reduce losses from scab and other soil-borne potato diseases.

The crop is generally harvested between September 25 and the middle of October, and special attention is paid to harvesting methods in order to eliminate as much bruising as possible, thus reducing the loss from decay following tuber injury.

PRODUCTION CENTERS AND VARIETIES GROWN, BY STATES

To aid the reader in acquiring general information relative to the potato industry of a given State, it seems desirable to present briefly a few important facts regarding potato production in each State. More specific information may be obtained from the State agricultural experiment stations, extension specialists, and county agents.

ARIZONA

In Arizona, potato production is rather limited, chiefly because potatoes can be successfully produced in only a few localities at high altitudes where irrigation water is available or where annual precipitation is from 18 to 25 inches.

At the lower altitudes in the southern part of the State, potatoes do fairly well when planted at the proper time and given good cultural care. Most of them are planted in February, earlier plantings being frequently injured by frost. The spring crop is harvested in June.

A fall crop is also grown in Arizona, being planted the latter part of August or early September and harvested in December.

Triumph, Irish Cobbler, and Katahdin are the principal varieties grown.

CALIFORNIA

The principal potato-producing districts in California are the delta lands of San Joaquin and Contra Costa Counties, sometimes referred to as the Stockton district; Kern County, in the south-central part of the State; and the Klamath potato district, along the northern boundary of the State in Siskiyou and Modoc Counties.

Owing to the large area of the State, planting and harvesting seasons extend over a considerable period. In the Stockton district plantings may be made from February to the middle of June. The early crop is planted in March or April and the late crop in May or the early part of June. In Kern County planting is done between November and the middle of March.

A large part of the land in the Stockton district is below sea level as well as below the river level. Irrigation water is taken from the river or canal through a head gate or a siphon and applied to the land in narrow ditches 24 to 30 inches deep, spaced 60 or 75 feet apart; from these the water moves through the soil. The principal varieties grown are the Burbank and White Rose (Wisconsin Pride, American Giant).

The elevation of the Kern County district ranges from 350 to 550 feet above sea level. The rainfall, which occurs between October 1 and May 1, averages about 5½ inches a year. As the rainfall is insufficient for potato production, the crop is grown under irrigation. The principal variety is White Rose.

The Klamath potato district has an elevation of from 4,035 to 4,200 feet. The annual rainfall is about 12.5 inches, most of it occurring between September and June. Irrigation water is obtained from Upper Klamath Lake and the Klamath River. Russet Burbank (Netted Gem) is the principal variety grown, although small acreages of White Rose, Burbank, and Triumph are also produced.

COLORADO

Colorado is the second-largest producer of potatoes of the Western States, being exceeded only by Idaho. The leading potato-production centers in Colorado are the Greeley district, in the northeastern part of the State; the San Luis Valley, in the south-central part; the western slope, which includes four counties in the Grand, Gunnison, and Uncompahgre Valleys; and the Eagle Valley-Carbondale district.

There are also a number of smaller potato districts that are of minor importance commercially but produce a considerable quantity of seed.

Until 1909 the Greeley district was much the largest production center in the State. In that year, and for several years thereafter, an unusual, severe, and widespread attack of what appears to have been psyllid yellows nearly ruined the potato industry. During this period, the San Luis Valley district became the leading center. With the subsidence of the disease the Greeley growers have increased their acreage but have not yet returned to their former acreage. Rural, Triumph, and Katahdin are the leading varieties grown for the late crop, and the Irish Cobbler and Triumph for the early crop. Although the major portion of the acreage is under irrigation, some dry-land seed potatoes are produced in the Greeley district.

The leading varieties grown in the San Luis Valley are Perfect Peachblow (Red McClure), Prolific (Brown Beauty), Triumph, and Russet Burbank. As in the Greeley district, the bulk of the crop is grown under irrigation. In the valleys or on the plateaus that are too high for the application of water, some excellent dry-land seed is produced. In the western-slope valleys, included in the general-production districts previously listed, the Rural, Peachblow, Katahdin, and Russet Burbank are the leading late varieties, and the Irish Cobbler and Triumph are the leading early-maturing varieties.

The minor potato districts of Colorado are the Northeastern, Divide, San Juan, Moffat, and South Park-Pike's Peak. Some excellent seed potatoes are produced in these districts; many of these crops are grown without irrigation.

IDAHO

Idaho is the largest producer of potatoes in the Western States. The acreage has been increased since the 1930 census report, the present planting being over 100,000 acres. The largest producing centers are Bingham, Bonneville, Twin Falls, Cassia, Minidoka, and Fremont Counties. Commercial potatoes are also produced to a lesser extent in Jefferson, Madison, Bannock, Canyon, Jerome, and Gooding Counties; in fact, all along the irrigated districts bordering on the Snake River. Idaho soils are admirably adapted to potato production, and tubers of exceptionally good quality are produced when proper cultural methods are employed. About 90 percent of the potatoes produced are Russet Burbank; the other varieties grown are Charles Downing, Idaho (Rural), Triumph, and Cobbler. Katahdin is being grown to some extent in northern Idaho on the cut-over lands.

Although Idaho produces mostly late-crop potatoes, some early varieties are also grown. There has been a considerable decline in recent years in the early-potato industry due to scab and unprofitable marketing.

The leading seed-producing counties are Fremont, Teton, Lewis, Valley, and Latah. In Fremont County most of the land is unirrigated. The seed produced in Lewis and Latah Counties is grown without irrigation; that grown in Teton and Valley Counties is irrigated.

It is the common practice of the commercial growers to buy certified seed and by keeping it fairly well isolated from badly diseased

fields to use the stock 2 to 5 years. Others purchase a small quantity of certified seed each year, increasing the stock for their commercial plantings the following year.

MONTANA

Potato production in Montana is not confined to any particular section of the State but is spread over a wide area. The important centers now include the Flathead Lake, Bitter Root, and Deerlodge Valleys, Helena, and the Milk River Valley in the northern part of the State. The seed districts are Flathead, Beaverhead, Lewis and Clark, Blaine, and Phillips Counties. Seed is also produced in a part of Hill County in the Milk River Valley.

The use of commercial fertilizers, particularly phosphorus, has been found to be beneficial in many sections of the State. increasing both the yield and the quality of the crop.

Most of the seed used in Montana is produced in the State, and some seed is also shipped to southern growers.

The important commercial varieties grown in Montana are Russet Burbank, Triumph, Irish Cobbler, Katahdin, and White Rose. Russet Burbank is grown almost exclusively in the western part of the State, whereas in the eastern part Triumph is the principal variety grown.

NEBRASKA

Potato growing in high altitudes of northwestern Nebraska is included in this bulletin because the cultural conditions there are very similar to those in neighboring States to the west. Both irrigated and dry-land potato growing is practiced in western Nebraska. The North Platte Valley in Scotts Bluff County is the principal irrigated section of the State; in 1937 the acreage was about 30,000 acres. This area continues north into the southern part of Sioux County and to the east into Morrill County. The other irrigated area is in Kimball County, where water is supplied both from a storage reservoir and with pumps from wells.

In the irrigated district, planting is done from May 1 to July 1; the potatoes planted previous to June are harvested in August or the first part of September; 75 to 80 percent of the crop is planted June 10 to June 20 and harvested September 25 to October 15.

The dry-land seed regions are principally in Box Butte, Sheridan, Dawes, Sioux, Kimball, and Banner Counties. Nebraska dry-land seed production was materially decreased in 1934–37 because of the drought.

The principal variety grown is the Triumph; Irish Cobbler is of minor importance. Most of the late-maturing varieties have been eliminated; however, Chippewa is showing some promise in the irrigated region. Nebraska has developed five distinct strains of Triumph that differ with regard to time of ripening. A midseason strain is grown mostly in the irrigated district and also in the dry-land territory. The late strains produce not only larger yields but also a larger percentage of rough tubers and are not considered as desirable as the early strains that yield a high percentage of smooth tubers.

NEVADA

According to the 1930 census report, Nevada produced 3,692 acres of potatoes in 1929. Of this, 3,661 acres were under irrigation, a slight increase over the acreage so reported in the census for 1919. The largest acreage is produced in Lyon and Washoe Counties. Large areas of the Newlands reclamation project and of Mason Valley are said to be well adapted to potato culture. The crop is generally planted from May 15 to June 1. Russet Burbank is the leading variety.

NEW MEXICO

The potato crop of New Mexico is of comparatively little commercial importance. The best yields are obtained from the Deming and Visden sections, where the crop is grown with irrigation during the cool season of the year. A spring and a fall crop are grown, but the former produces the better yields. It is the practice of some growers to irrigate the land 2 or 3 weeks before planting, to insure good moisture for germination. The spring crop is planted from March 15 to April 15; the late crop from July 25 to August 10. The principal varieties are Irish Cobbler, Triumph, and Peachblow.

Dry-land seed is produced in the high-altitude sections in the northern part of the State. Best results are obtained if the plants are up when the rainy season starts, which is about the first of July.

OREGON

Oregon has two very distinctive types of climatic conditions, the western part of the State being humid, whereas the eastern half has a more or less semiarid climate.

The largest production centers are the Klamath, Willamette Valley, Malheur, central Oregon, and the Blue Mountain districts. The Klamath district grows about 20,000 acres of potatoes annually. There is an ample supply of water for irrigation purposes from Upper Klamath Lake, streams, and reservoirs. Russet Burbank is the leading commercial variety. Two main crop rotations are used; the first is alfalfa 5 or 6 years, followed by 3 years of potatoes; the second is grain, alsike clover seed 2 years, and potatoes 2 years. Growers use from 400 to 600 pounds of 16–20–0 fertilizer. The Willamette Valley district includes the counties of Washington, Multnomah, Clackamas, and Marion. Many different varieties are grown in this large district. Practically all of the Willamette Valley is nonirrigated, and many different crop rotations are followed. Potatoes are planted in late June or July and harvested in November or December. The Malheur district in the extreme southeastern part of the State produces mostly early potatoes that are shipped in July. Triumph is the principal variety.

Dry-land seed potatoes are produced in the Blue Mountain district in the northeastern part of the State. The rainfall is generally sufficient to produce a good crop if proper dry-land farming practices are employed.

UTAH

Utah produces some early, midseason, and late potatoes. Box Elder, Weber, and Davis Counties lead in the production of early

and midseason potatoes. The principal varieties grown in these counties are Cobbler and Triumph. The late crop is produced in Cache, Salt Lake, Sevier, and Millard Counties. Russet Burbank and Triumph are the leading varieties grown for the late crop. Some seed potatoes are produced in Piute County, in the south-central portion of the State, but much of the seed is shipped in from other States.

WASHINGTON

The climatic conditions of Washington are very similar to those of Oregon, in that the western portion of the State is humid and the eastern part semiarid, the rainfall of eastern Washington being somewhat greater than that of eastern Oregon. The largest potato-producing counties are Yakima, Spokane, Kittitas, Benton, and Clark. Yakima County produces over one-half of the yearly production of the State. Russet Burbank is the leading commercial variety grown in Washington.

Early potatoes are produced in Yakima, Benton, Franklin, and Walla Walla Counties. Irish Cobbler and Triumph are grown mostly for the early crop.

Seed potatoes are grown principally in Skagit, Snohomish, and Whatcom Counties, in the western part of the State, and in Kittitas, Spokane, Pend Oreille, and Whitman Counties, in eastern Washington.

In the irrigated districts the following crop rotation is, in general, used: Wheat, oats, or corn, 1 year; alfalfa, 2 to 4 years; potatoes, 1 to 2 years.

In western Washington, where the temperature very seldom falls far below freezing, potatoes are stored in barns or sheds; in the eastern part of the State they are stored in pits, dugout cellars, and various types of storage rooms.

WYOMING

In potato production Wyoming occupies ninth position in the group of States under consideration. Of the 19,952 acres grown in 1929, 7,890 acres were grown under irrigation. Goshen and Park Counties are the leading irrigated districts. In the Torrington district, in Goshen County, potato production is of comparatively recent development. The soil is well suited to the potato. The Triumph is the leading commercial variety. Powell is the center of the potato-producing area of Park County.

Wyoming produces a considerable acreage of dry-land seed potatoes. The Triumph is also the leading variety in the dry-land sections.

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